



INTERMOUNTAIN STATION

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ABSTRACT: Queensland-maple seedlings planted on lava rockland in Hawaii grew slowly in the first year. Growth rates accelerated during the next 3 years, although fertilizer treatments were ineffective. The trees averaged 7 feet in height after 4 years. Early growth of Queensland-maple in Hawaii compares favorably with that in young plantations in Australia and in Central Malaya.

Queensland-Maple Seedlings in Hawaii...

growth accelerated after first year

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Rapid growth of tree seedlings is a desirable characteristic that helps to insure successful plantation establishment. This quality is especially important in tropical and sub-tropical regions where weed competition is severe. Such is the case where reforestation projects are underway on Hawaii's lava rockland areas.

Queensland-maple (*Flindersia brayleyana* F. Muell.), a high-quality hardwood tree native to Australia, is a promising species for these conditions. One of the most prized cabinet woods of Australia, it is considered equal to mahogany or walnut. And it is light in weight, easily worked, readily stained, and frequently highly figured.¹

Favorable growth in a four-year old arboretum, near Hilo, Hawaii, prompted the Hawaii Division of Forestry in 1961 to establish a Queensland-maple plantation nearby. We found that seedlings grew slowly the first year, but accelerated quickly after that. Fertilizers failed to help growth.

Study Site

The study area is in the Waiakea Forest Reserve, island of Hawaii, at an

elevation of 980 feet. Annual rainfall averages about 180 inches, but varies greatly from year to year. Mean annual temperature is 72°F., with extremes ranging from about 54° to 86°F. Under these climatic conditions tree growth continues the year-round.

The native vegetation is typical ohia-treefern rain forest. Large, scattered ohia (*Metrosideros collina* [Forst.] Gray) trees were left standing when the site was cleared in 1961. Weed species that occupied the site after it was cleared included Malabar melastome (*Melastoma malabathricum* L.), Hawaiian treefern (*Cibotium* spp.), swordfern (*Nephrolepis* spp.), thimbleberry (*Rubus rosaeifolius* Smith) and broomsedge (*Andropogon virginicus* L.).

The soil is a Kiloa extremely rocky silty clay loam. It is a lithosol and is classified as a Histic Aeric Tropaquept (3.18 AER-10). Sato² has described this series:

"...has a surface layer of black organic matter mixed with varying amounts of mineral matter derived primarily from ash deposits. The high organic matter content may impart a mucky appearance and feel. This material rests on aa lava and may infiltrate among the underlying stones to depths of 15 to 30 inches.

¹Boas, I.H. *The commercial timber in Australia, their properties and uses.* 344 pp., illus. Council for Scientific and Industrial Research, Commonwealth of Australia. 1947.

²Sato, Harry. *Soils of the Panaewa Farm Lots.* 2 pp. U.S. Soil Conserv., Hilo, Hawaii. 1964.

This soil is characteristically extremely stony, and is low in inherent fertility. Crops require a complete fertilizer to obtain economic yields. The soil is strongly acid, ranging in pH from 5.1 to 5.5. Runoff is very slow and permeability is very rapid. The soil profile will transmit 15 to 25 inches of water per hour. The soil has a very low water holding capacity, holding approximately one-half inch of available water per profile and consequently depends upon frequent replenishment by rains. Stones and boulders are so numerous that use of tillage equipment is impractical except for bulldozers and rollers.¹¹

Methods

Seeds were obtained from trees growing in Oahu, Hawaii. Seedlings were from 6 to 10 inches tall when outplanted in October 1961 at a spacing of 10 ft. by 10 ft. Ten months later they averaged only one foot in height. At that time nine fertilizer treatments were used in an experimental attempt to increase growth before the seedlings became suppressed by native vegetation.

One application of each fertilizer was made to 10 trees, in a randomized block design. The fertilizers were placed on the soil surface within a radius of 18 inches around each tree. The amounts of active elements applied to the seedlings ranged from 23 to 35 grams of nitrogen, 14 to 27 grams of phosphorus, and 13 to 46 grams of potassium (table 1). These rates are comparable to local orchard applications.

Periodic measurements of the 100 trees in the study were made to determine early growth and the effects of the fertilizers. Heights were measured at 10, 22, 38, and 46 months after planting. Stem diameters (breast height) were measured after 46 months. The smaller seedlings were released from competition at 22 and 36 months.

Table 1.--Fertilizer treatments, growth and survival of Queensland-maple, Waiakea Forest Reserve, Hawaii, 1961-65 (basis: 83 trees)

Fertilizer		Average heights at...						Survival ²
Treatment (N-P-K) ¹	Rate of fertilization per tree	10 months	22 months	38 months	46 months			
					Height	Std. dev.	Range	
	<i>Grams</i>	<i>Feet</i>						<i>Percent</i>
12-27-7	N - 27 P - 27 K - 13	1	3	12	18	6	6 -24	80
14-14-14	N - 32 P - 14 K - 26	1	4.5	11.5	16.5	11	2 -31.5	70
0-22-0	P - 22	1	4	11	16	10	1.5-29	3/90
21-0-0	N - 24	1	3.5	10.5	15	6	7.5-26	80
0-0-61	K - 19	1	3.5	12	15.5	9.5	.5-28	3/100
15-0-41	N - 23 K - 46	1.5	4.5	12.5	16	13	1 -31	70
0-20-10	P - 20 K - 19	1	3	9.5	12.5	8	3 -28.5	100
46-0-0	N - 35	1	5	13.5	19.5	6	13 -26	60
21-0-0	N - 24	1	3.5	10.5	15	7.5	3.5-25.5	100
0-22-0	P - 22	1	5	16.5	21.5	7.5	8.5-29.5	100
None	0	1	5	16.5	21.5	7.5	8.5-29.5	100
Average all treatments		1	4	12	17	8.5	.5-31	85

¹N = nitrogen; P = phosphorus; K = potassium.

²Each survival figure based on 10 seedlings per fertilizer treatment applied 10 months after planting.

³Includes 1 seedling severed during a cleaning.

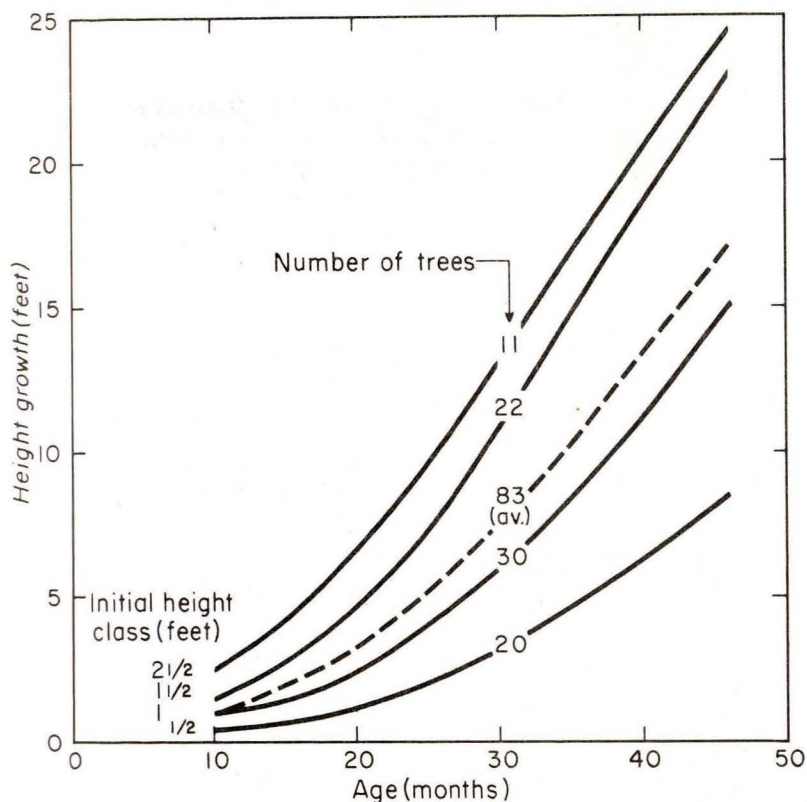


Figure 1.--Rate of growth of Queensland-maple seedlings, grouped by height classes reached at 10 months after planting.

Results

The growth rate of the seedlings accelerated rapidly after the first year. In their second year, height increase averaged 3 feet. During the third and fourth years, annual growth averaged 6-1/2 feet (fig. 1).

The slower growing seedlings were suppressed by the rank growth of grasses and shrubs despite two cleanings. Fourteen of the 100 seedlings first measured at 10 months died during the next year. One more died before our observations were ended. Two seedlings were severed during a cleaning operation, so their performance has been omitted.

Those seedlings more than 1 foot tall 10 months after planting easily outgrew the weed species (fig. 2). They had an average height of 7 feet at 22 months, and had reached 24 feet just 2 years later.

We observed striking differences in height and diameter growth for the seedlings in the four height classes recorded at 10 months (table 2). The annual growth of the smallest seedlings over the subsequent 3 years continued to be poor when compared with the more vigorous seedlings. Likewise, most mortality occurred among the smaller seedlings.

Trees failed to show a positive response to the fertilizers over the 3-year period following treatment. The average height growth of the fertilized trees was somewhat less than that of the unfertilized trees. Growth of individuals within treatments varied greatly; certain fertilized trees continued to outgrow the unfertilized trees (table 1).

Micro-site differences--primarily the nonuniform occurrence of soil among the lava rocks--and suppression by weeds may have accounted for the



Figure 2.--A 4 year-old Queensland-maple tree 31-1/2 feet tall, 3.2 inches in diameter breast height.

Table 2.--Growth and survival of Queensland-maple, by seedling height at 10 months, Waiakea Forest Reserve, Hawaii, 1962-65 (basis: 83 trees)

Height (ft.) at 10 months	Average annual growth ¹	Average height 46 months	Average d.b.h. 46 months	Survival after 4 years ²
	Feet	Feet	Inches	Percent
Less than 0.8	2.7	8.5	0.7	67
0.8-1.2	4.7	15.0	1.4	89
1.3-1.7	7.2	23.0	2.5	96
1.8-3.2	7.3	24.5	2.5	100

¹The 3-year period between 10th and 46th month's measurements.

²Basis: 100 trees.

wide range of growth among the saplings. Planting stock quality and inherent differences are two other factors which could have played a part.

On the basis of this study, it appears that early growth of Queensland-maple on Hawaii's rockland areas is comparable to that in central Malaya³ and Australia⁴ (table 3).

³Mitchell, B. A. *The place of exotics in Malayan forestry*. Malayan Forest Res. Inst. Ministry Agr., Fed. Malaya. 12 pp. 1962.

⁴Swain, E. H. F. *A silvicultural note on maple silkwood (Flindersia brayleyana)*. Queensland Forest Serv., Brisbane, Austral. Bull. 8. 16 pp., illus. 1928.

Table 3.--Comparisons of early growth of Queensland-maple in Hawaii, Malaya, and Australia

Location	Trees	Age	Height		Diameter breast height	
			Average	Range	Average	Range
	No.	Months	Feet		Inches	
Waiakea Forest Reserve Hawaii Island	¹ /83	46	17	0.5-31.5	1.7	0.0-3.7
Waiakea Arboretum Hawaii Island	30	96	40	4 -60	4.9	.0-8.7
Central Malaya	--	72	25	--	3.0	--
Central Malaya	(² %)	72	26	--	3.4	--
Queensland, Australia	4	91	--	--	5.9	--
Queensland, Australia	10	136	--	--	8.1	--
Queensland, Australia	10	136	31	--	8.6	--

¹Includes 73 trees fertilized and 10 trees unfertilized.

²Fertilizers applied to unknown number of trees.

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